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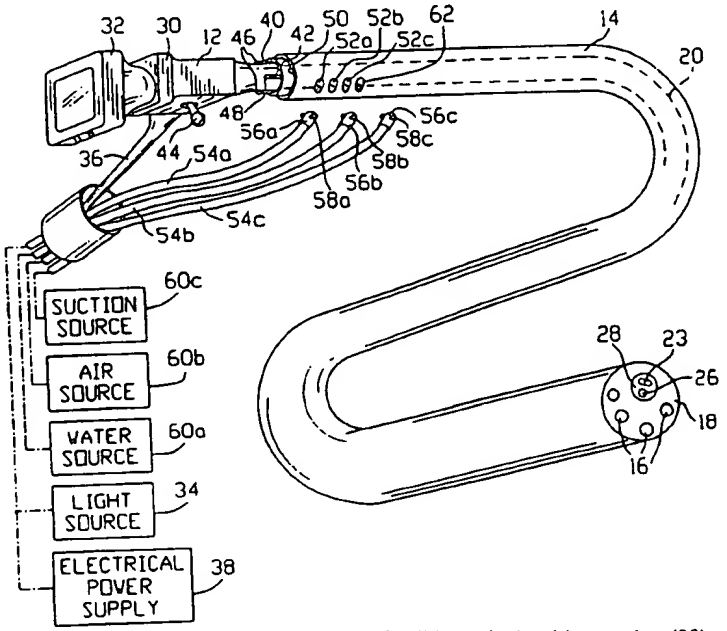

(57) Abstract

An endoscope comprises a hand held control module (12), a flexible optical guide member (20) permanently or temporarily connected at a proximal end to the control module (12), and a disposable insertion tube (14) removably attached at a proximal end to at least one of the control module (12) and the optical guide member (20), the insertion tube (14) being provided with a longitudinal channel (76) for receiving the optical guide member. Images are transmitted from a distal end (18) of the insertion tube either by an optical fiber bundle (26), an electrical lead (88) or a wireless transmitter (156). The insertion tube (14) is closed at a distal end (18) by a transparent element (28). A plurality of longitudinal ducts (16) extend to respective openings at the distal end (18) of the insertion tube (14), coupling elements (52a, 52b, 52c) being provided for connecting suction (54c) and fluid supply hoses (54a, 54b) to the ducts (16) in the insertion member.

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ENDOSCOPE WITH DISPOSABLE INSERTION MEMBER

Background of the Invention

This invention relates to endoscopes.

An endoscope is a medical instrument which includes a flexible insertion member which is insertable into a patient's digestive tract, either through the colon or through the mouth or nose. A fiber optic light guide passes longitudinally through the endoscope insertion memebr for carrying electromagnetic radiation from a source into the patient. Light reflected from the patient's internal body tissues is transmitted in organized form back along the endoscope insertion member to a control member and focused by lenses in an eyepiece for viewing by an endoscopist or other operator.

The flexible insertion member is provided with various channels for guiding water, air and different endoscopic instruments from the control module at the proximal end of the insertion member to the distal end thereof. One of the channels is used for providing suction at the distal end of the insertion member.

An endoscope, including an insertion member and a control module, as well as an ancillary light and power guide line, is a single piece of equipment. It is expensive to buy and maintain, heavy, and difficult to clean. Moreover, it breaks easily and is frequently out of service.

Objects of the Invention

An object of the present invention is to provide an improved endoscope.

Another object of the present invention is to provide an endoscope which is less expensive to buy.

A similar object of the present invention is to provide an endoscope which is less expensive to maintain in an operating condition.

Another, more particular, object of the present invention is to provide an endoscope which is easier to clean and maintain in a sterile condition.

A further particular object of the present invention is to provide an endoscope with a control module and a disposable insertion member.

Yet another particular object of the present invention is to provide an endoscope with a control module which can be used for both colonic and esophageal investigations.

An endoscope comprises, in accordance with a general conceptualization of the present invention, a hand held control module, a flexible optical guide member permanently or removably connected at a proximal end to the control module, and a disposable insertion tube removably attached at a proximal end to at least one of the control module and the optical guide member, the insertion tube being provided with a longitudinal channel for receiving the optical guide member. The optical guide member includes a transmission component for transmitting an optical signal from a distal end of the optical guide member to the control module and further includes a flexible sheath permanently attached to and surrounding the transmission component. The channel in the insertion tube is closed at a distal end of the insertion tube, preferably by a transparent element.

Pursuant to another feature of the present invention, the insertion tube is further provided with a plurality of longitudinal ducts extending to respective openings at the distal end of the insertion tube.

Pursuant to more specific features of the present invention, the transmission component includes an optical fiber bundle, while the optical guide member further includes an auxiliary transmission component (e.g., an optical fiber) for transmitting electromagnetic radiation from the control module to the distal end of the guide member. Alternatively, the transmission component includes an electrical lead, and a charge coupled device mounted to a distal end of the optical guide member is operatively connected to the electrical lead for generating thereon a video signal encoding the image.

Pursuant to an additional feature of the present invention, the endoscope further comprises at least one coupling device on the insertion tube at a proximal end thereof for releasably connecting suction and fluid supply hoses to the ducts in the insertion tube. The coupling device is spaced from the control module.

Pursuant to a supplemental feature of the present invention, the optical guide member and the insertion tube are provided with keying means for ensuring that the optical guide

orientation with respect thereto.

Pursuant to yet another feature of the present invention, the endoscope further comprises (a) a mechanical actuation component extending longitudinally through the insertion tube and operatively connected to the distal end thereof for effectuating a turning of the distal end of the insertion tube and the optical guide member, (b) a manual actuator on the control module for selectively operating the mechanical actuation means to turn the distal end of the insertion tube, and (c) a coupling device on the control module and the proximal end of the insertion tube for operatively connecting the manual actuator to the mechanical actuation component.

An endoscope component comprises, in accordance with a another general conceptualization of the present invention, a disposable flexible insertion tube provided with a plurality of channels extending longitudinally through the insertion tube to a distal end thereof. A first coupling device is provided at a proximal end of the insertion tube for releasably connecting the insertion tube to an endoscope control module. Additional coupling devices are provided on the insertion tube proximate to a proximal end thereof for releasably connecting suction and fluid supply hoses to the insertion tube so that the hoses communicate with respective insertion tube channels. The additional coupling devices are spaced at least slightly from the proximate end of the insertion tube. The insertion tube may include a light guide channel for receiving a flexible optical guide member permanently connected at a proximal end to the control module, the guide channel being closed at the distal end of the insertion tube.

An endoscope assembly comprises, in accordance with the present invention, a casing, a charge coupled device disposed inside the casing for providing an image of internal body tissues proximate to the casing, an endoscope insertion member, and a mounting element on at least one of the insertion member and the casing for removably mounting the casing to a distal end of the insertion member.

According to a particular feature of the present

the wireless transmitter being operatively connected to the CCD.

The endoscopic component may further comprise a light source in the casing. In that event, the casing has a window on a side of the casing opposite the attachment device, whereby light from the source can be emitted to irradiate internal body tissues of a patient upon a securing of the casing to the distal end of the endoscope insertion member.

The endoscopic assembly may also comprise a power supply in the casing, the power supply being operatively connected to the CCD, the wireless transmitter and the light source.

Pursuant to another feature of the present invention, the mounting element of the endoscopic component includes electrical contacts, the CCD being operatively connected to the contacts for transmitting therethrough a video signal encoding the image.

An endoscope comprises, in accordance with a relatively particular embodiment of the present invention, a hand held control module and a disposable insertion tube provided with a plurality of channels extending longitudinally through the insertion tube to a distal end thereof. Attachment elements are provided for releasably attaching a proximal end of the insertion tube to the control module. A mechanical actuation component (e.g., a cable or cables) extends longitudinally through the insertion tube and is operatively connected to the distal end of the insertion member for effectuating a turning thereof. A manual actuator on the control module selectively operates the mechanical actuation component. A first coupling device on the control module and the proximal end of the insertion tube serves to operatively connect the manual actuator to the mechanical actuation component. Additional coupling devices are provided on the insertion tube at a proximal end thereof for releasably connecting suction and fluid supply hoses to the insertion tube, the additional coupling device being spaced from the control module. An imaging device is disposed at least at the distal end of the insertion tube for providing an image of internal

According to another feature of the present invention, the imaging device includes a flexible optical guide member permanently or temporarily connected at a proximal end to the control module. The guide member includes a transmission component for transmitting an optical signal from a distal end of the flexible optical guide member to the control module. The guide member further includes a flexible sheath permanently attached to and surrounding the transmission component.

Pursuant to a specific feature of the present invention, the transmission component includes an optical fiber bundle. Alternatively, the transmission component includes an electrical lead. In the latter case, the imaging device further includes a charge coupled device or CCD mounted to a distal end of the optical guide member. The CCD is operatively connected to the electrical lead for generating thereon a video signal encoding the image.

Pursuant to an additional feature of the present invention, the optical guide member further includes an auxiliary transmission element, e.g., an optical fiber, for transmitting electromagnetic radiation from the control module to the distal end of the guide member.

According to another feature of the present invention, the insertion tube includes a channel for receiving the optical guide member, the channel being closed at the distal end of the insertion tube.

An endoscope in accordance with the present invention is less expensive to buy and less expensive to maintain than conventional endoscopes. Also, the present endoscope is easier to clean and maintain in a sterile condition.

An endoscope in accordance with the present invention is less expensive in part because th same control module can be used for both colonic and esophageal investigations and endoscopic operations.

Brief Description of the Drawing

Fig. 1 is partially a block diagram and partially a schematic perspective view, partly exploded, of an endoscope in accordance with the present invention.

posable endoscope insertion tube in accordance with the present invention.

Fig. 3 is a partial longitudinal cross-sectional view of an optical guide member and a surrounding disposable insertion tube illustrated in Fig. 1.

Fig. 4 is a partial longitudinal cross-sectional view of another optical guide member and a surrounding disposable insertion tube in accordance with the present invention.

Fig. 5 is a schematic perspective view of an endoscope control module in accordance with the present invention.

Fig. 6 is a schematic perspective view of an optical guide member and a disposable insertion tube utilizable with the endoscope control module of Fig. 5.

Fig. 7 is a diagram of an endoscope component including a charge coupled device for removable insertion into a chamber at a distal end of a disposable endoscope insertion member.

Fig. 8 is a block diagram of the endoscope component of Fig. 7.

Fig. 9 is a diagram, similar to Fig. 7, of another endoscope component including a charge coupled device in accordance with the present invention, indicating the insertion of the charge-coupled device into the distal end of a disposable endoscope insertion member in accordance with the present invention.

Fig. 10 is a longitudinal cross-sectional view of a distal end of an optical guide member and a disposable endoscope insertion member in accordance with the present invention.

Fig. 11 is a longitudinal cross-sectional view of a distal end of another optical guide member and disposable endoscope insertion member in accordance with the present invention.

Fig. 12 is a block diagram of functional components of an endoscope control module in accordance with the present invention.

Fig. 13 is schematic elevational view of a distal

video signal generating component, in accordance with the present invention.

Detailed Description

As illustrated in Fig. 1, an endoscope comprises a hand held control module 12 and a disposable insertion tube 14 provided with a plurality of ducts or channels 16 extending longitudinally through the insertion tube to a distal end 18 thereof. A flexible optical guide member 20 is permanently connected at a proximal end to control module 12 and is slidably inserted into insertion tube 14.

As depicted in Fig. 3, optical guide member 20 includes an image transmission component in the form of a fiber optic bundle 22 for transmitting an optical signal from distal end 18 of insertion tube 14 (and of optical guide member 20) to control module 12. Disposed distally of a distal end of fiber optic bundle 22 is a lens or other optical component 23 for focusing incoming light onto the distal end of the fiber optic bundle. Lens 23 and fiber optic bundle 22 serve to provide an image of internal body tissues proximate to distal end 18 of insertion tube 14.

Optical guide member 20 further includes a flexible sheath 24 permanently attached to and surrounding fiber optic bundle 22 and an auxiliary transmission element in the form of an optical fiber 26 for transmitting electromagnetic radiation from control module 12 to distal end 18 of insertion tube 14 and guide member 20.

A transparent element or window 28 is provided at distal end 18 of insertion tube 14 for enabling the transmission of electromagnetic radiation from optical fiber 26 and for enabling the transmission of reflected radiation from a patient's internal body tissues to fiber optic bundle 22.

As further illustrated in Fig. 1, fiber optic bundle 22 is operatively connected at a proximal end to a charge coupled device ("CCD") 30 mounted to control module 12. CCD 30 converts incoming electromagnetic radiation into video signals which are supplied to a video monitor 32 also mounted to control module 12. It is to be noted that disposable insertion tube 14 may be used with a more conventional configura-

are replaced with focusing optics and an eyepiece (not shown) or wherein a remote video monitor (not shown) is substituted for attached video monitor 32.

The outgoing electromagnetic radiation carried by optical fiber 26 originates in a light source 34 operatively connected to control module 12 via a line 36. Line 36 also carries electrical power from a supply 38.

Insertion tube 14 carries two pairs of mechanically actuated cables 40 and 42 which are selectively placed in tension, in response to manipulations of a joystick 44 by an operator, to adjust the orientation or curvature of insertion tube 14 and concomitantly optical guide member 20 at the distal end thereof. Cables 40 and 42 are connected to the distal end of insertion tube 14 for effectuating a turning thereof. Attachment or coupling elements 46 and 48 are provided at the proximal ends of cables 40 and 42 for releasably and attaching the cables to control module 12 for operation by joystick 44.

The proximal end of insertion tube 14 may be provided with a lip 50 or other coupling element for removably connecting insertion tube 14 to control module 12.

As additionally illustrated in Fig. 1, coupling devices 52a, 52b, and 52c are provided on insertion tube 14 at a proximal end thereof for releasably connecting a water supply hose 54a, an air supply hose 54b, and a suction hose 54c to insertion tube 14. Coupling devices 52a, 52b, and 52c are spaced from control module 12 and are attachable to respective coupling elements 56a, 56b, and 56c on free ends of hoses 54a, 54b, 54c. Coupling elements 56a, 56b, and 56c carry respective manually operative valve members 58a, 58b, and 58c. Hoses 54a, 54b, and 54c extend from a water source 60a, a source of pressurized air 60b, and a vacuum or suction source 60c, respectively.

In using the endoscope of Fig. 1, insertion tube 14 is slid over optical guide member 20 and attached to control module 12. Insertion tube 14 together with optical guide member 20 is then inserted into a patient and used in essentially the same manner as a conventional endoscope. A biopsy forceps or other flexible endoscopic operating instrument (not shown)

tion tube 1. Upon the termination of the operation, insertion tube 14 and optical guide member 20 are withdrawn from the patient. Insertion tube 14 is then detached from control module 12 and optical guide member 20 is removed from insertion tube 14. Insertion tube 14 is discarded, while control module 12 and optical guide member 20 are ready for immediate use with another disposable insertion tube 14. There is no need to subject optical guide member 20 to sterilizing and cleaning operations which may damage the optical guide and eventually wear it down.

It is to be noted that the same control module 12 and optical guide member 20 may be used with insertion tubes of different sizes. Some insertion tubes may omit various ducts or channels 16 and 62, particularly in cases where the endoscopic operation is confined to a visual inspection.

As shown in Fig. 2, an insertion tube 64 for use with control module 12 and optical guide member 20 of Fig. 1 may include all of the components of insertion tube 14, namely, a plurality of ducts or channels 66 extending longitudinally through the insertion tube to a distal end 68 thereof, a transparent element or window 70 at the distal end of the tube, and two pairs of mechanically actuated cables 72a, 72b and 74a, 74b. Insertion tube 64 is provided with a longitudinally extending channel 76 for receiving optical guide member 20 (Fig. 1). Channel 76 and concomitantly optical guide member 20 have an irregular shape (e.g., oval), for enabling a keying of optical guide member 20 to the insertion tube. Alternatively, one or more key slots 78 may extend from channel 76 for receiving corresponding projections (not illustrated) on optical guide member 20.

Fig. 4 illustrates another flexible optical guide member 80 and disposable insertion tube 82. Insertion tube 82 is provided with a plurality of ducts or channels 84a, 84b extending longitudinally through the insertion tube to a distal end 86 thereof. A optical guide member 80 is connected or connectable at a proximal end to a control module (not shown) and is slidably inserted into insertion tube 82.

Optical guide member 80 includes an image transmis-

mitting a video signal from distal end 86 of insertion tube 82 (and of optical guide member 80). The video signal is generated by a charge coupled device or CCD 90 disposed at the distal end of optical guide member 80 proximally of a lens or other optical component 92 which focuses incoming light onto CCD 90. Lens 92 and CCD 90 serve to provide an image of internal body tissues proximate to distal end 86 of insertion tube 82.

Optical guide member 80 further includes a flexible sheath 94 permanently attached to and surrounding electrical lead 88, as well as an auxiliary transmission element in the form of an optical fiber 96 for transmitting electromagnetic radiation from a control module (not shown) to distal end 86 of insertion tube 82 and guide member 80.

A transparent element or window 98 is provided at distal end 86 of insertion tube 82 for enabling the transmission of electromagnetic radiation from optical fiber 96 and for enabling the transmission of reflected radiation from a patient's internal body tissues to CCD 90 via lens 92.

Electrical lead 88 may extend to a video monitor (not shown) which is on a control module (not shown) or remote. Insertion tube 82 is provided with selectively tensioned cables (not shown) for turning the distal end of the insertion tube and concomitantly optical guide member 80 to facilitate viewing of objects internal to a patient.

As depicted in Fig. 5, an endoscope control module 100 comprises a body or main housing 102 to which a joystick actuator 104 is pivotably connected. Joystick 104 is operatively connected inside housing 102 to two pairs of cable coupling elements 106a, 106b and 108a, 108b. Electrical power for operating motors (not shown) to selectively exert tension via cable coupling elements 106a, 106b and 108a, 108b is supplied to housing 102 via an external cable 110.

Control module 100 is provided with an optical connector 112 for receiving a proximal end of an optical guide member 114 (Fig. 6). Optical connector 112 includes a pair of optical ports 116 and 118 for forming light transmitting connections with an optical fiber 120 and a fiber optic bundle

and a proximal end of optical guide member 114 have irregular or keyed shapes (e.g., oval) for ensuring a proper alignment of optical ports 116 and 118 with optical fiber 120 and fiber optic bundle 122, respective. Connected to housing 102 is a housing extension 124 which encloses a charge coupled device or CCD (not shown). A video monitor 126 is fixed to housing extension 124 and is operatively connected to the CCD.

Fig. 6 shows a disposable flexible insertion tube 128 which temporarily receives optical guide member 114. Insertion tube 128 is provided at a distal end with a coupling lip or flange 130 for releasably fastening the insertion tube to control module 100. Insertion tube 128 is further provided with a plurality of ducts or channels 132 extending longitudinally through the insertion tube to a distal end 134 thereof. A transparent element or window 136 is provided at distal end 134 of insertion tube 128, and particularly at the distal end of a longitudinal channel in insertion tube 128 which receives optical guide member 114. Window 136 transmits electromagnetic radiation from optical fiber 120 and reflected radiation from a patient's internal body tissues to CCD 90 via lens 92. Coupling devices 138a and 138b are provided on insertion tube 128 at a proximal end thereof for releasably connecting a fluid supply hose (not illustrated) and a suction hose (not illustrated) to insertion tube 128. Coupling devices 138a and 138b are spaced from control module 100. Insertion tube 128 is also provided with a biopsy channel port 140 for enabling the insertion of a biopsy forceps or other endoscopic instrument. Proximal end of insertion tube 128 carries cable coupling elements 142a, 142b and 144a, 144b which releasably lock to cable coupling elements 106a, 106b and 108a, 108b on housing 102.

As illustrated in Figs. 7 and 8, an endoscope image transmission component comprises a casing 150 which contains a charge coupled device or CCD 152, a lens or other optical transmission element 154, a wireless transmitter 156, a power supply 158, and a light source 160. The CCD 152 converts incoming electromagnetic radiation, focused by lens 154, into an image-encoding video signal which is transmitted by trans-

body. Power supply 158 provides electrical power to CCD 152, transmitter 156, and light source 160.

Prior to an endoscopic operation, casing 150 is inserted into a chamber 162 located at the distal end of a flexible endoscopic insertion member 164. Casing 150 is retained in chamber 162 by an at least partially transparent door 166 or other mounting member pivotably attached to the distal end of insertion member 164. As described hereinabove with reference to other embodiments, insertion member 164 has a plurality of longitudinally extending channels or ducts 168 and 170 for the guidance of air, water, suction underpressure, and endoscopic instruments from hoses (not illustrated) at a proximal end of insertion member 164 to the distal end thereof. Insertion member 164 is also provided with two pairs of coacting tension cables 172 for turning a distal end of the endoscope insertion member.

As depicted schematically by dot-dash lines in Fig. 7, casing 150 may be inserted in a disposable, at least partially transparent bag or envelope 174 prior to insertion in chamber 162. The bag or envelope serves to maintain the sterility of casing 150 and to enable repeated use thereof without long sterilization procedures between successive operations. Bag or envelope 174 is preferably sterile prior to the disposition of casing 150 therein.

Casing 150 is provided with one or more transparent wall portions or windows 176 and 178, whereby light from source 160 can be emitted to irradiate internal body tissues of a patient upon a securing of casing 150 to the distal end of insertion member 164 and whereby reflected radiation from internal body tissues is transmitted to lens 154 and CCD 152.

It is to be noted that a locking mechanism for maintaining tension on the cables is advantageously provided in an endoscope control module or an endoscope insertion member of any embodiment described herein.

It is to be further noted that many other mounting devices are available to one skilled in the art, for retaining or removably connecting casing 150 to the distal end of an endoscope insertion member. For example, casing 150 may be

cooperates with a snap lock element in the distal end of the insertion member to removably retain the casing thereon (see discussion below with reference to Fig. 13).

As illustrated in Fig. 9, an endoscope image transmission component comprises a casing 180 which contains a charge coupled device or CCD 182, and a lens or other optical transmission element 184. Prior to an endoscopic operation, casing 180 is inserted into a chamber 186 located at the distal end of a flexible endoscopic insertion member 188. Casing 180 is retained in chamber 186 by an at least partially transparent door 190 or other mounting member pivotably attached to the distal end of insertion member 188. As described above, insertion member 188 has a plurality of longitudinally extending channels or ducts 192 and 194 for the guidance of air, water, suction underpressure, and endoscopic instruments from hoses (not illustrated) at a proximal end of insertion member 188 to the distal end thereof. Insertion member 188 is also provided with two pairs of coacting tension cables 196 for turning a distal end of the endscope insertion member 188.

CCD 182 converts incoming electromagnetic radiation, focused by lens 184, into an image-encoding video signal which is transmitted over a pair of electrical contacts 198 and 200 disposed on a proximal wall of casing 180 and a wall or surface of chamber 186, respectively. Contact 200 is connected to a lead 202 which extends longitudinally through insertion member 188. Another lead 204 also extends longitudinally through insertion member 188 to provide electrical powe to CCD 182 via a pair of electrical contacts 206 and 208 on a wall of chamber 186 and casing 180, respectively.

Light energy is emitted at a distal end of insertion member 188 by an optical fiber 210 extending through insertion member 188 from a proximal end to a distal end thereof. Optical fiber 210 may extend to light source in a control module (neither shown) or, alternatively, to a remote light source (not shown), either through the control module or by-passing the control module.

As depicted schematically by dot-dash lines in Fig. 9, casing 180 may be inserted in a disposable, at least par-

chamber 186. Bag or envelope 212 serves to maintain the sterility of casing 180 and to enable repeated use thereof without long sterilization procedures between successive operations. Bag or envelope 212 is preferably sterile prior to the disposition of casing 180 therein.

Casing 180 is provided with a transparent wall portion or window 214, whereby reflected radiation from internal body tissues is transmitted to lens 184 and CCD 182.

As depicted in Fig. 10, casing 180 of Fig. 9 may be inserted in a chamber 216 at a disal end of an image guide member 218. A pair of electrical leads 220 and 222 extend through image guide member 218 for delivering electrical power to CCD 182 (Fig. 8) in casing 180 and for transmitting encoded visual images from the CCD to a video monitor (not shown) which is remote or which is mounted to a control module (not shown). Electrical power is transmitted over contacts 224 from lead 220 to casing 180, while image encoding video signals are transmitted from casing 180 to lead 222 over contacts 226.

An optical fiber 228 for providing illumination extends through image guide member 218 or through an insertion tube 227, as indicated in phantom lines at 229. As discussed hereinabove, image guide member 218 is slidably inserted inside insertion tube 227. In addition, insertion tube 227 is provided with fluid and suction channels (not shown) and tensioning cables (not shown).

Transparent windows 230 and 232 are provided at the distal ends of image guide member 218 and insertion tube 226, respectively.

As depicted in Fig. 11, casing 150 of Figs. 7 and 8 may be inserted in a chamber 234 at a distal end of an image guide member 236. An optical fiber 238 for providing illumination extends through image guide member 236 or through an insertion tube 240, as indicated in phantom lines at 242. Image guide member 236 is slidably inserted inside insertion tube 240. In addition, insertion tube 240 is provided with fluid and suction channels (not shown) and tensioning cables (not shown). Transparent windows 244 and 246 are provided at

240, respectively.

As shown schematically in Fig 12, an endoscope control module 250 houses a pair of reversible drive motors 252 and 254 for selectively exerting tension on respective cable pairs 256a, 256b and 258a, 258b. Control module 250 also houses a power supply such as a battery 260 and a light source 262 for generating electromagnetic radiation for transmission down an optical fiber 264.

As illustrated schematically in Fig. 13, a casing 266 housing a CCD (not shown) is removably connected via snap lock elements 268 and 270 to a distal end of an endoscope inertion member 272. A video signal from the CCD may be transmitted wirelessly or, alternatively, over electrical leads extending through the insertion member 272.

Although the invention has been described in terms of particular embodiments and applications, one of ordinary skill in the art, in light of this teaching, can generate additional embodiments and modifications without departing from the spirit of or exceeding the scope of the claimed invention. For example, a disposable endoscopic insertion tube as described herein may be used with control modules having conventional rotary cable-tensioning knobs, light transmission components, etc. Accordingly, it is to be understood that the drawings and descriptions herein are proferred by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.

CLAIMS:

1. An endoscope comprising:

a hand held control module;

a disposable insertion tube, said insertion tube being provided with a plurality of channels extending longitudinally through said insertion tube to a distal end thereof;

means for releasably attaching a proximal end of said insertion tube to said control module;

mechanical actuation means extending longitudinally through said insertion tube and being operatively connected to said distal end for effectuating a turning of said distal end;

manual actuator means on said control module for selectively operating said mechanical actuation means to turn said distal end;

first coupling means on said control module and said proximal end of said insertion tube for operatively connecting said manual actuator means to said mechanical actuation means;

second coupling means on said insertion tube at a proximal end thereof for releasably connecting suction and fluid supply hoses to said insertion tube, said coupling means being spaced from said control module; and

imaging means at least at said distal end of said insertion tube for providing an image of internal body tissues proximate to said distal end.

2. The endoscope defined in claim 1 wherein said imaging means includes a flexible optical guide member connected at a proximal end to said control module, said guide member including transmission means for transmitting an optical signal from a distal end of said flexible optical guide member to said control module, said guide member further including a flexible sheath permanently attached to and surrounding said transmission means.

3. The endoscope defined in claim 2 wherein said transmission means includes an electrical lead, said imaging means further including a charge coupled device disposed at a

device being operatively connected to said electrical lead for generating thereon a video signal encoding said image.

4. The endoscope defined in claim 3 wherein said guide member is provided at a distal end with a chamber, said charge coupled device being removably disposed in said chamber.

5. The endoscope defined in claim 2 wherein said transmission means includes an optical fiber bundle.

6. The endoscope defined in claim 2 wherein said optical guide member further includes auxiliary transmission means for transmitting electromagnetic radiation from said control module to the distal end of said guide member.

7. The endoscope defined in claim 2 wherein said insertion tube includes a channel for receiving said optical guide member, said channel being closed at the distal end of said insertion tube.

8. The endoscope defined in claim 2 wherein said guide member is permanently affixed to said control module.

9. The endoscope defined in claim 2 wherein said guide member is releasably attached to said control module.

10. The endoscope defined in claim 1 wherein said imaging means includes a charge coupled device disposed on said insertion tube at said distal end, said imaging means further including a wireless transmitter at said distal end, said wireless transmitter being operatively connected to said charged coupled device.

11. The endoscope defined in claim 9 wherein said charge coupled device and said wireless transmitter are disposed in a casing removably disposed at said distal end.

imaging means also includes a light source in said casing.

13. The endoscope defined in claim 12 wherein said imaging means also includes a power supply in said casing, said power supply being operatively connected to said charge coupled device, said wireless transmitter and said light source.

14. An endoscope comprising:

a hand held control module;

a flexible optical guide member permanently connected at a proximal end to said control module, said guide member including transmission means for transmitting an optical signal from a distal end of said optical guide member to said control module, said guide member further including a flexible sheath permanently attached to and surrounding said transmission means; and

a disposable insertion tube removably attached to at least one of said control module and said optical guide member, said insertion tube being provided with a longitudinal channel for receiving said optical guide member, said channel being closed at a distal end of said insertion tube.

15. An endoscope defined in claim 14 wherein said insertion tube is further provided with a plurality of ducts extending longitudinally through said insertion tube to respective openings at the distal end of said insertion tube.

16. The endoscope defined in claim 15, further comprising coupling means on said insertion tube at a proximal end thereof for releasably connecting suction, water supply and air supply hoses to said ducts, said coupling means being spaced from said control module.

17. The endoscope defined in claim 14 wherein said channel is closed by a transparent element.

18. The endoscope defined in claim 14 wherein said

19. The endoscope defined in claim 14 wherein said optical guide member further includes auxiliary transmission means for transmitting electromagnetic radiation from said control module to the distal end of said guide member.

20. The endoscope defined in claim 14 wherein said transmission means includes an electrical lead, said imaging means further including a charge coupled device mounted to a distal end of said optical guide member, said charge coupled device being operatively connected to said electrical lead for generating thereon a video signal encoding said image.

21. The endoscope defined in claim 14 wherein said optical guide member and said insertion tube are provided with keying means for ensuring that said optical guide member is inserted into said channel at a predetermined orientation with respect thereto.

22. The endoscope defined in claim 14, further comprising:

mechanical actuation means extending longitudinally through said insertion tube and operatively connected to the distal end thereof for effectuating a turning of the distal end of said insertion tube and said optical guide member;

manual actuator means on said control module for selectively operating said mechanical actuation means to turn the distal end of said insertion tube; and

coupling means on said control module and the proximal end of said insertion tube for operatively connecting said manual actuator means to said mechanical actuation means.

23. An endoscope assembly comprising:

a casing;

a charge coupled device disposed inside said casing for providing an image of internal body tissues proximate to said casing;

an endoscope insertion member; and

member and said casing for removably mounting said casing to a distal end of said insertion member.

24. The endoscope assembly defined in claim 23, further comprising a wireless transmitter disposed in said casing, said wireless transmitter being operatively connected to said charged coupled device.

25. The endoscope assembly defined in claim 24, further comprising a light source in said casing, said casing being provided with a window, on a side opposite said means for removably attaching, whereby light from said source can be emitted to irradiate internal body tissues of a patient.

26. The endoscope assembly defined in claim 25, further comprising a power supply in said casing, said power supply being operatively connected to said charge coupled device, said wireless transmitter and said light source.

27. The endoscope assembly defined in claim 23, further comprising a light source in said casing, said casing being provided with a window, on a side opposite said means for removably attaching, whereby light from said source can be emitted to irradiate internal body tissues of a patient.

28. The endoscope assembly defined in claim 27, further comprising a power supply in said casing, said power supply being operatively connected to said charge coupled device and said light source.

29. The endoscope assembly defined in claim 23, further comprising electrical contacts on said casing and said insertion member, said charge coupled device being operatively connected to the electrical contacts for transmitting therethrough a video signal encoding said image.

30. The endoscope assembly defined in claim 23 wherein said means for removably mounting includes a chamber

retaining said casing in said chamber.

31. The endoscope assembly defined in claim 23 wherein said insertion member is provided at a distal end with a chamber for receiving said casing, said mounting means including means on at least one of said casing and said insertion member for removably retaining said casing in said chamber.

32. An endoscope component comprising:

a casing;

a charge coupled device disposed inside said casing for providing an image of internal body tissues proximate to said casing; and

a wireless transmitter disposed in said casing, said wireless transmitter being operatively connected to said charged coupled device.

33. An endoscope component comprising:

a casing;

a charge coupled device disposed inside said casing for providing an image of internal body tissues proximate to said casing; and

releasable coupling means on said casing for operatively coupling said charge coupled device to an endoscope insertion member to enable transmission of video signals from said charge coupled device through said endoscope insertion member.

34. An endoscope component comprising:

a disposable flexible insertion tube, said insertion tube being provided with a plurality of channels extending longitudinally through said insertion tube to a distal end thereof;

first coupling means at a proximal end of said insertion tube for releasably connecting said insertion tube to an endoscope control module; and

second coupling means on said insertion tube

suction and fluid supply hoses to said insertion tube so that said hoses communicate with respective ones of said channels, said second coupling means being spaced from the proximate end of said insertion tube.

35. The endoscope defined in claim 34 wherein said insertion tube includes a light guide channel for receiving a flexible optical guide member permanently connected at a proximal end to the control module, said guide channel being closed at the distal end of said insertion tube.

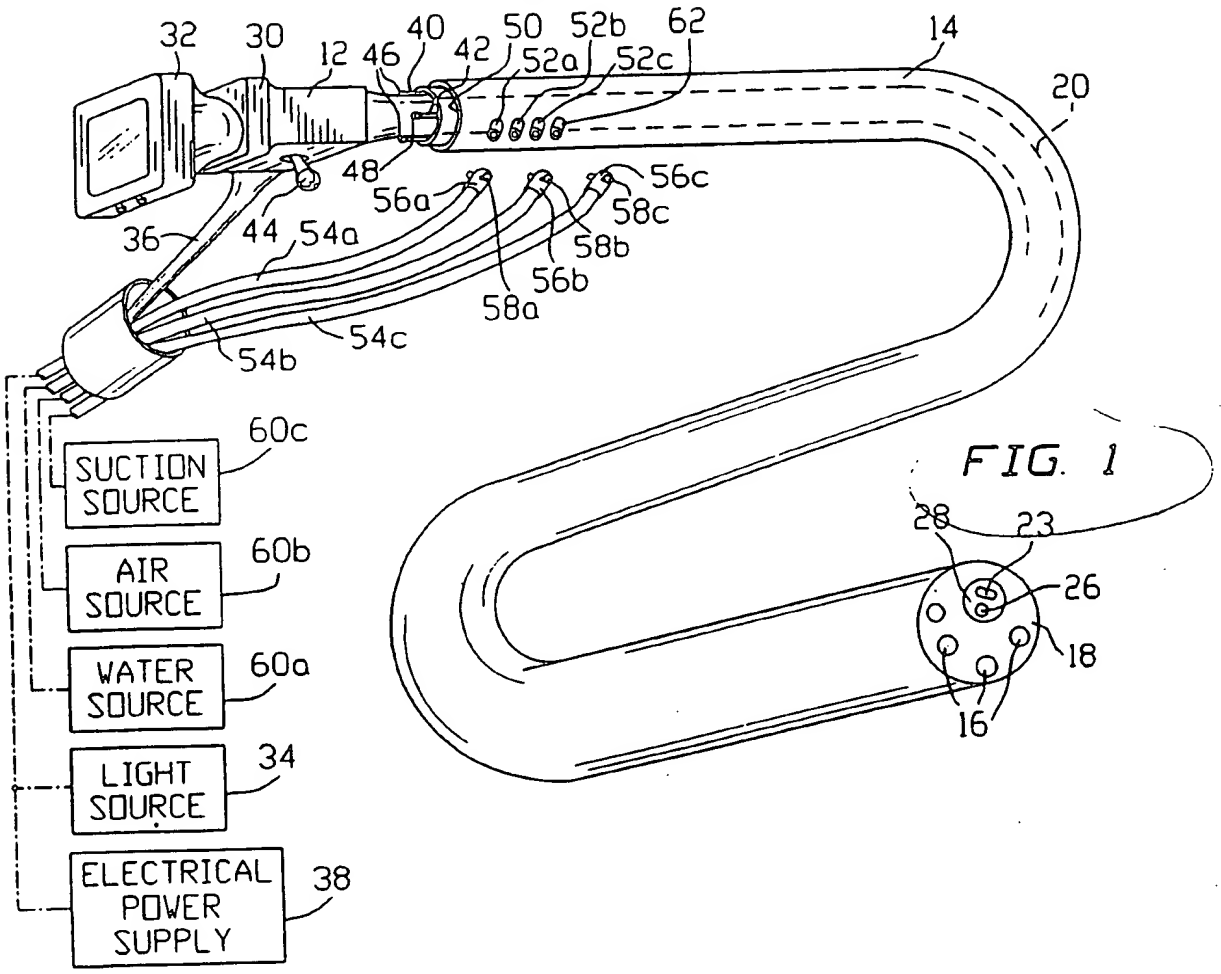

FIG. 1

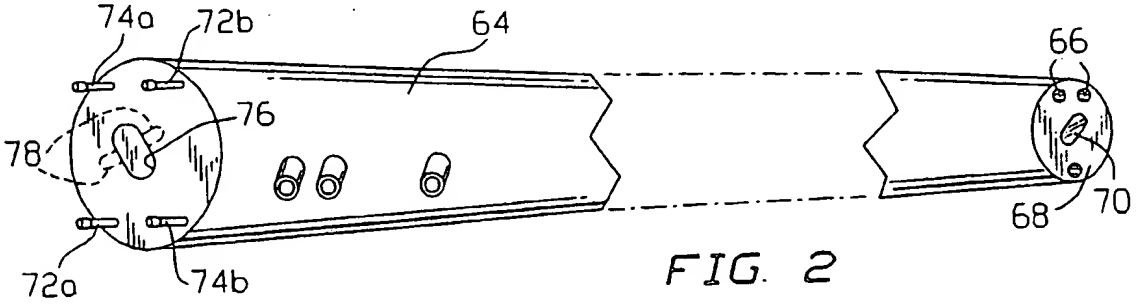

FIG. 2

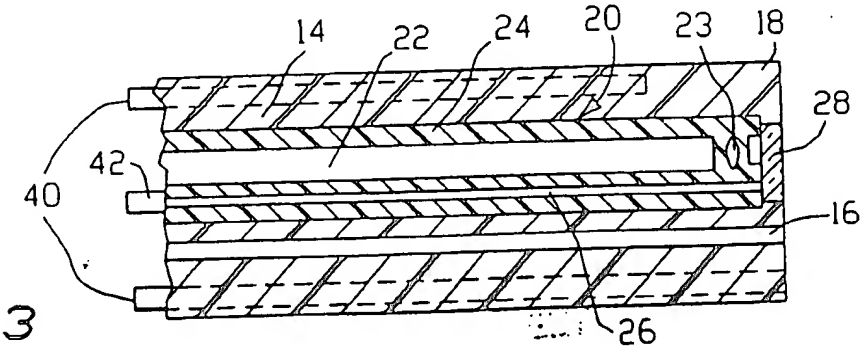

FIG. 3

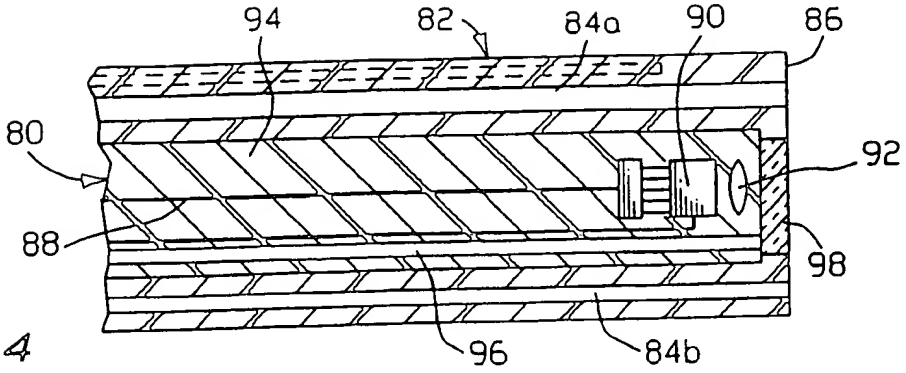

FIG. 4

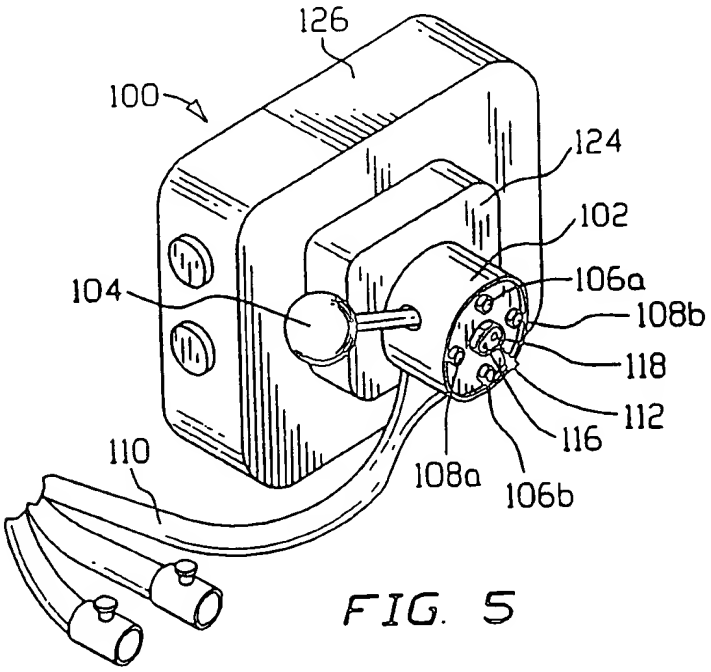

FIG. 5

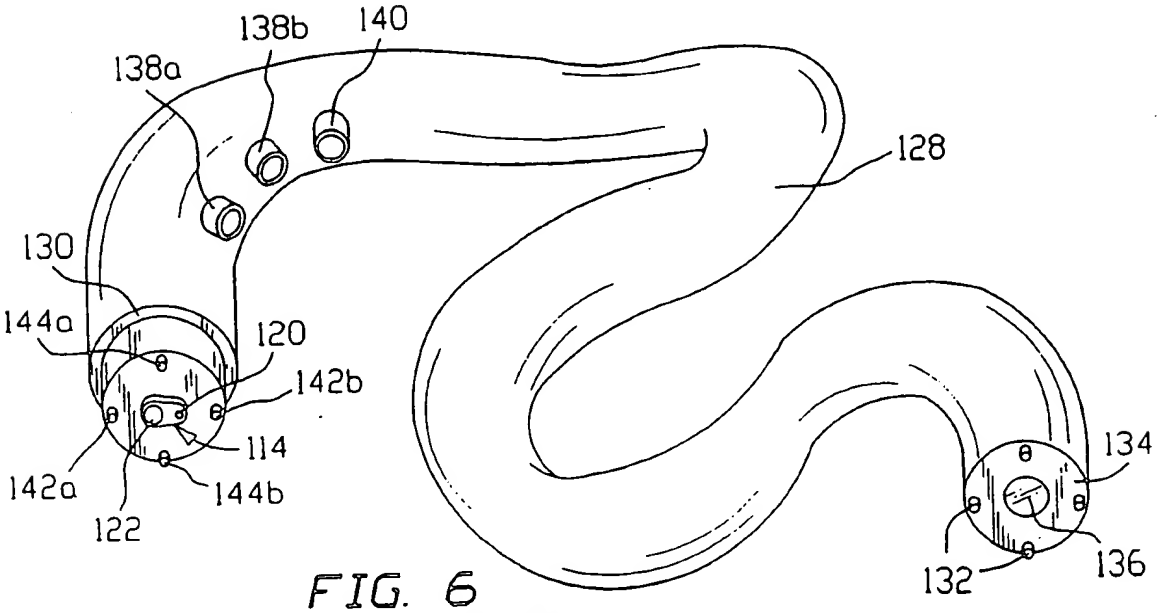

FIG. 6

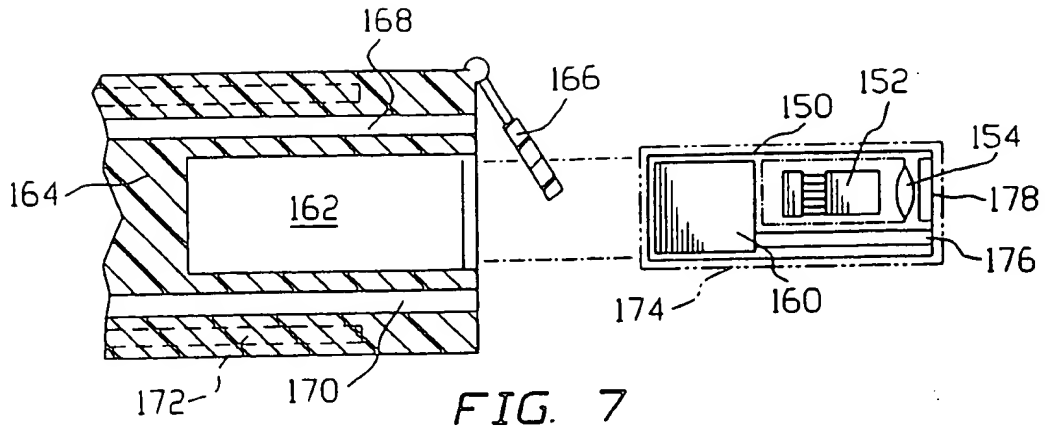

FIG. 7

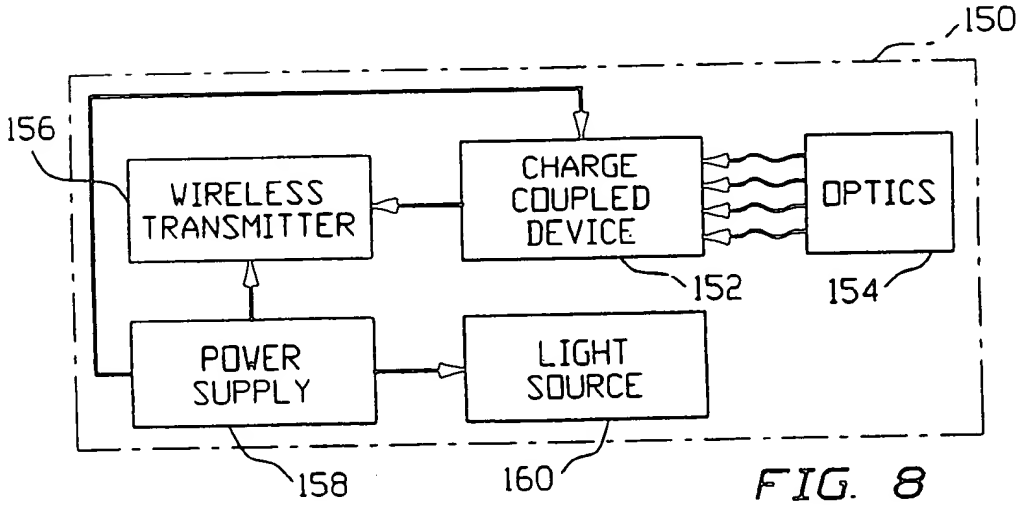

FIG. 8

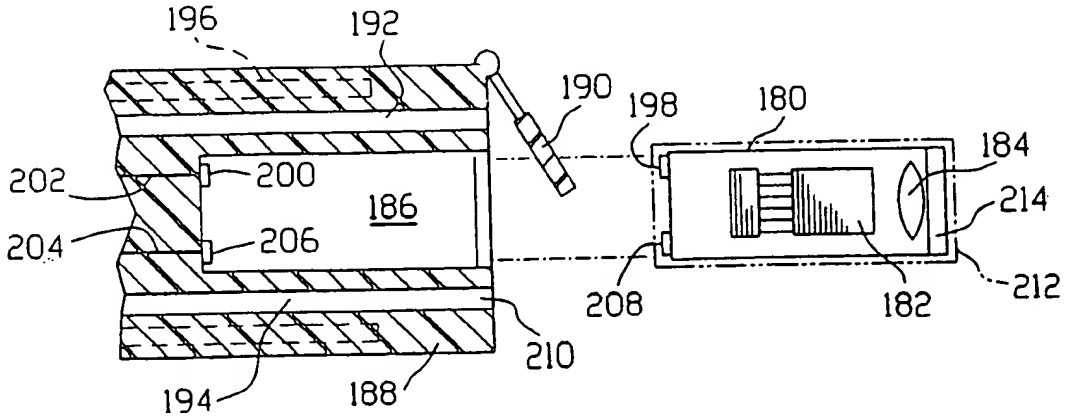

FIG. 9

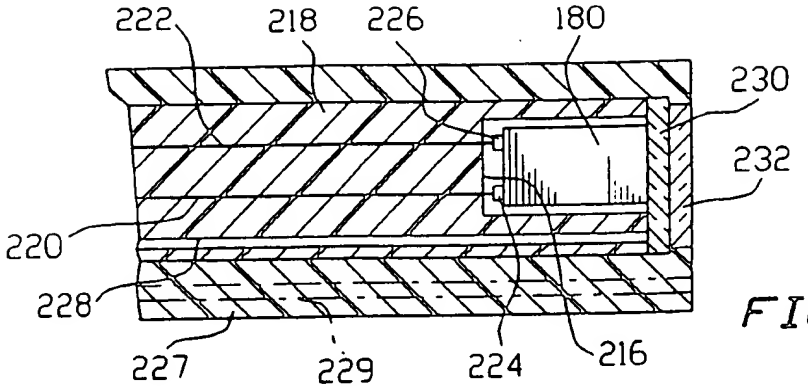

FIG. 10

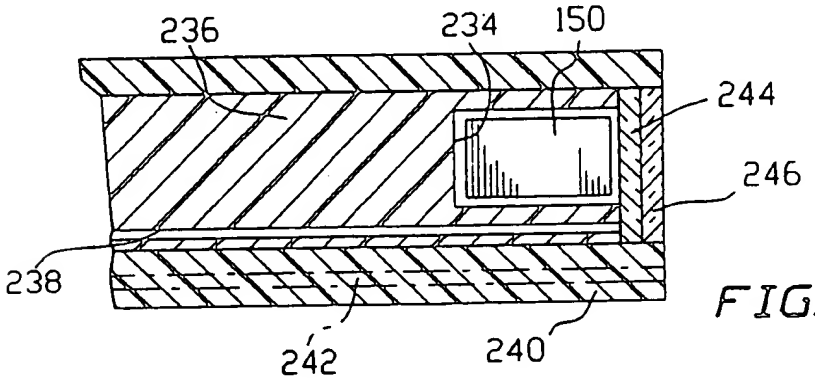

FIG. 11

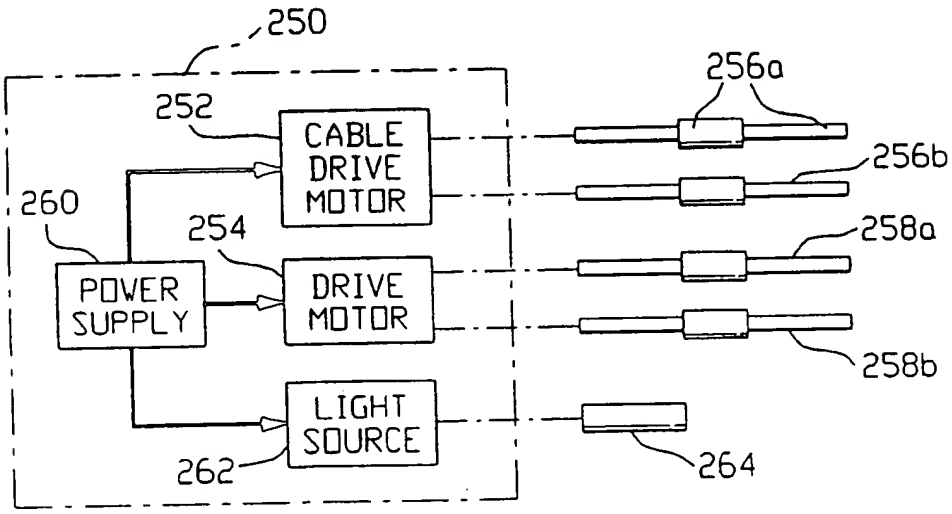

FIG. 12

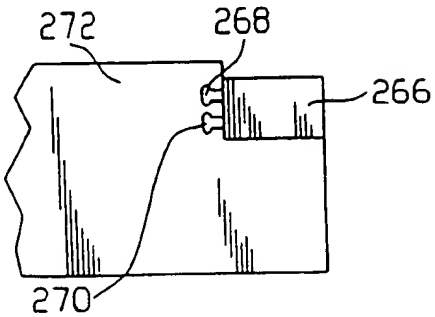

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/01020

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A61B 1/00,1/06
US CL :128/6,4

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 128/7,8,9,10,11,772; 358/98

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4,869,238 (OPIE ET AL.) 26 September 1989, See figures 1-3.	14,17,19
X	US, A, 4,895,138 (YABE) 23 January 1990, See col. 6, lines 36-53.	29,31,33
X	US, A, 4,918,521 (YABE ET AL.) 17 April 1990, See figure 13.	32
Y	US, A, 4,911,148 (SOSNOWSKI ET AL.) 27 March 1990, See col. 4, lines 25-28, col. 4, lines 33-37.	1,2,4-7,9,10
Y	US, A, 4,919,112 (SIEGMUND) 24 April 1990, See figure 1 and col. 2, lines 59-63.	1,2,5,6,9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 APRIL 1993	28 JUN 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer JOHN P. LEUBECKER Telephone No. (703) 308-0858

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/01020

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 3,12,18,23,30,34
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

PCT Article 17(2)(a)(ii)
Claims 3,12,18,23,30, and 34 are incomplete and therefore incomprehensible.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.